

FIG. 1

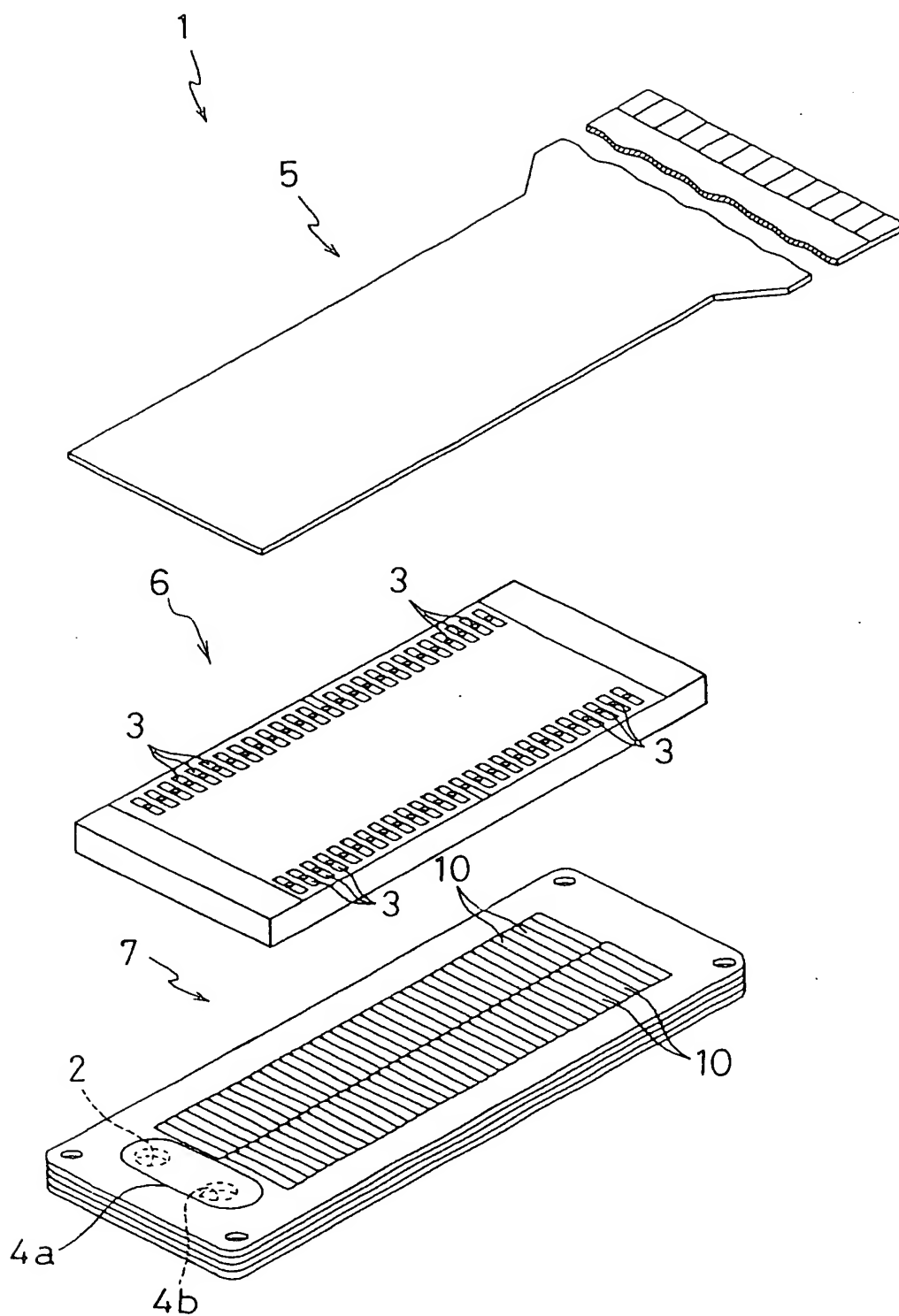


FIG. 2

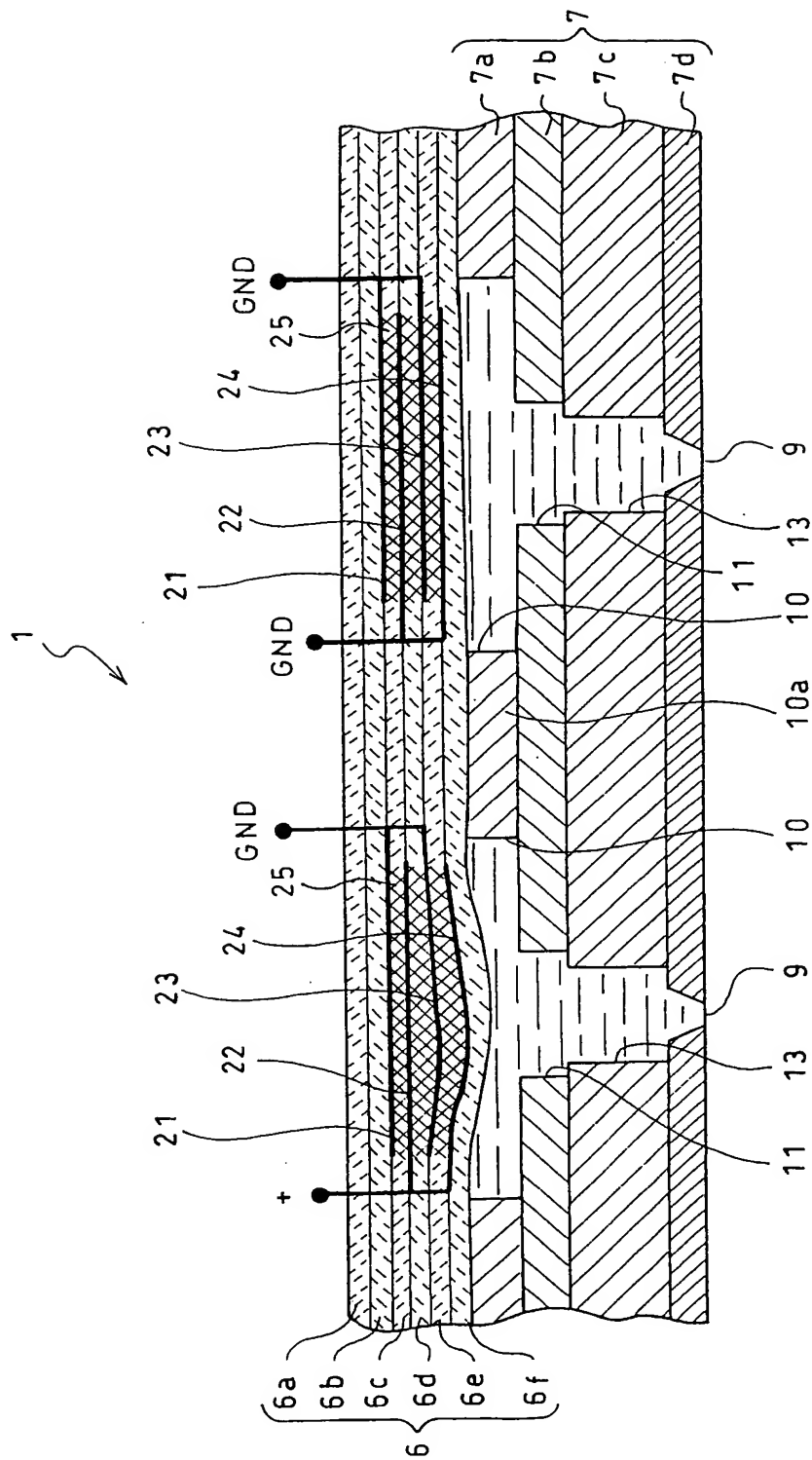


FIG. 3

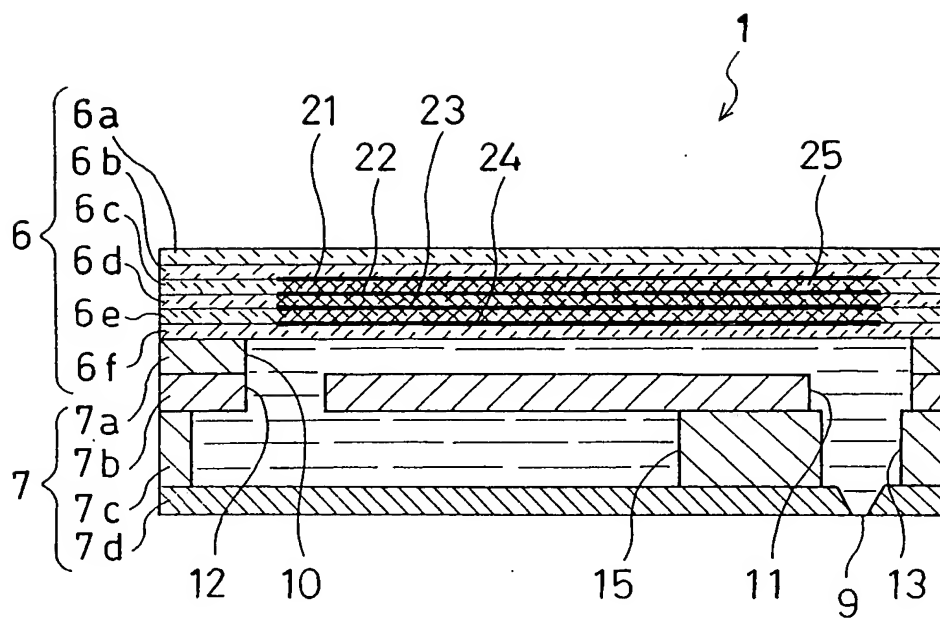


FIG. 4

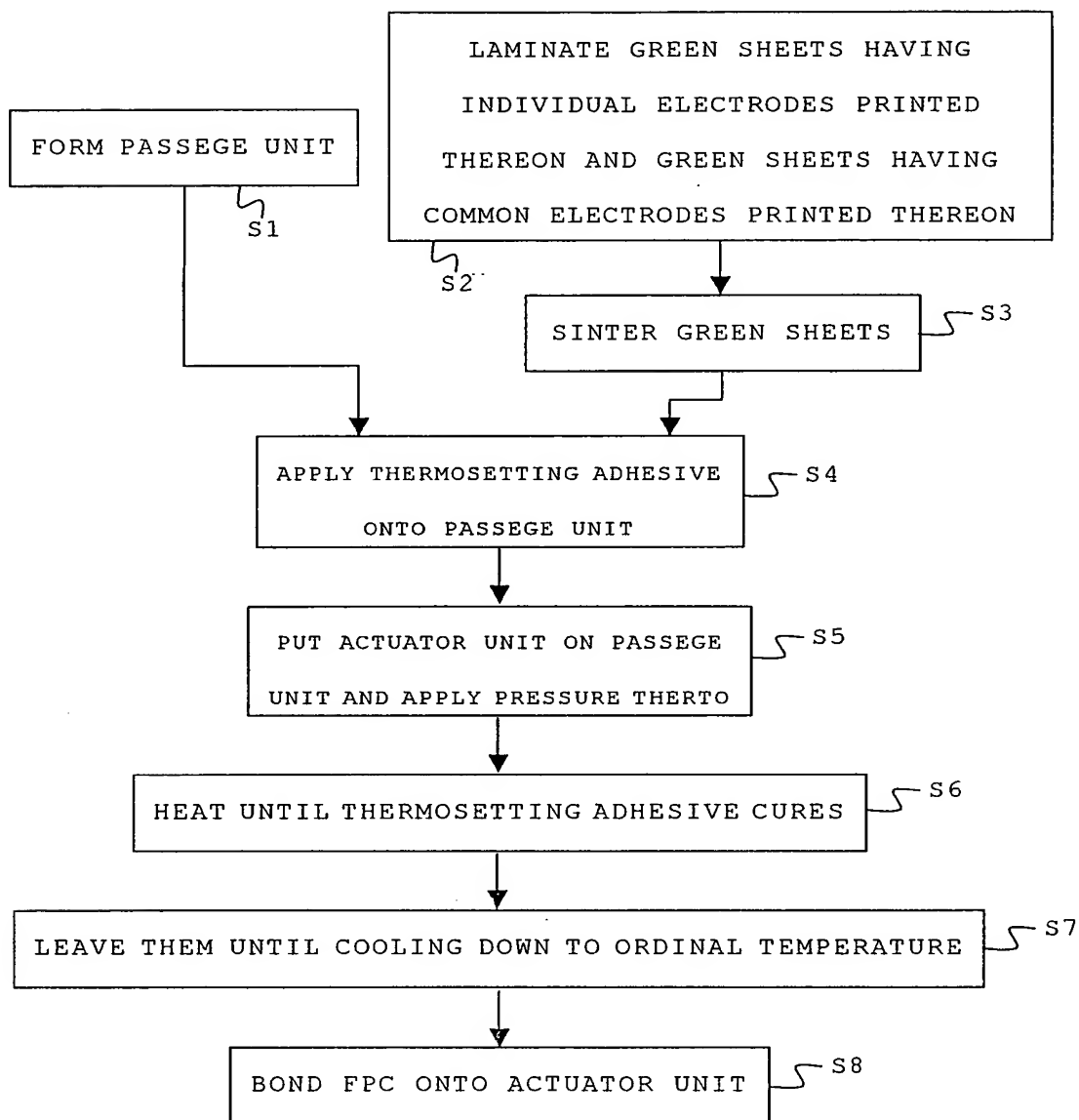


FIG. 5A

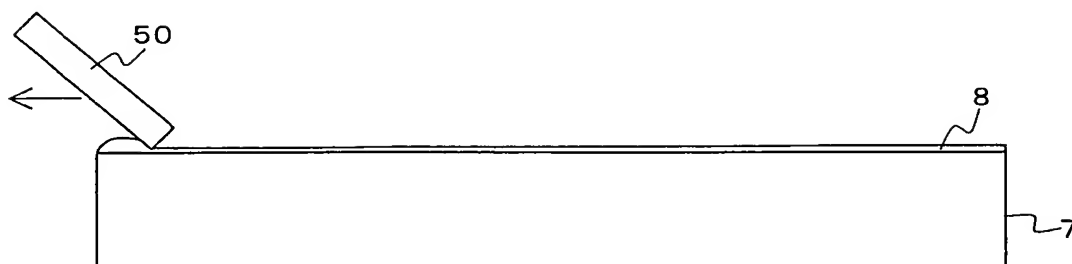


FIG. 5B

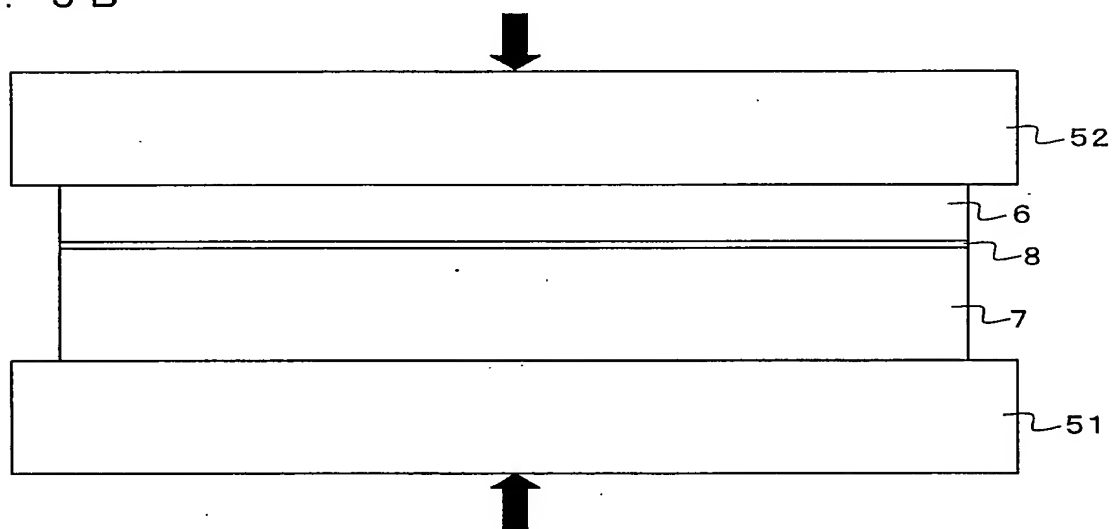
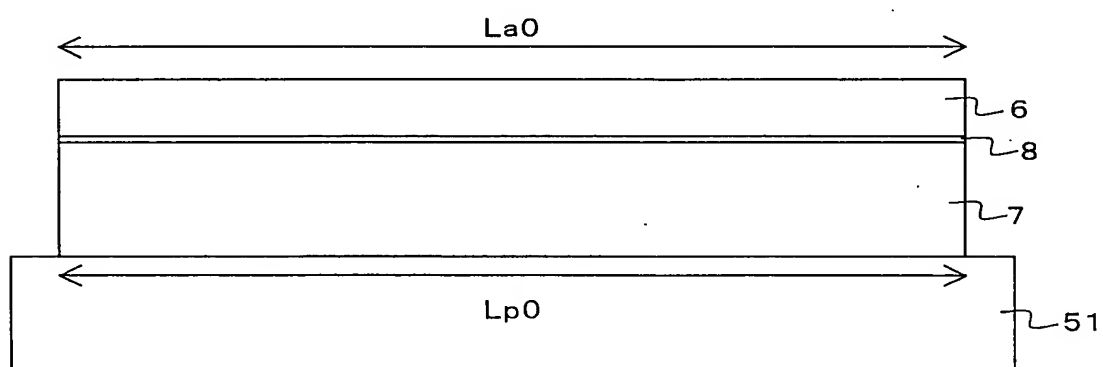
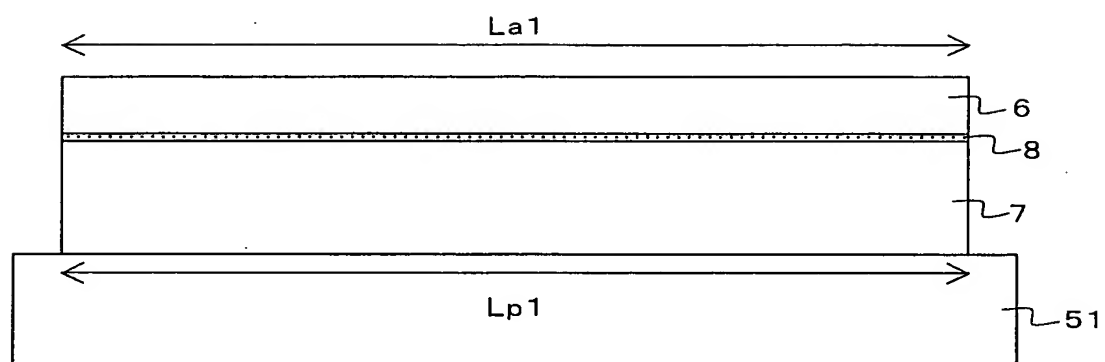


FIG. 5C



F I G. 5 D



F I G. 5 E

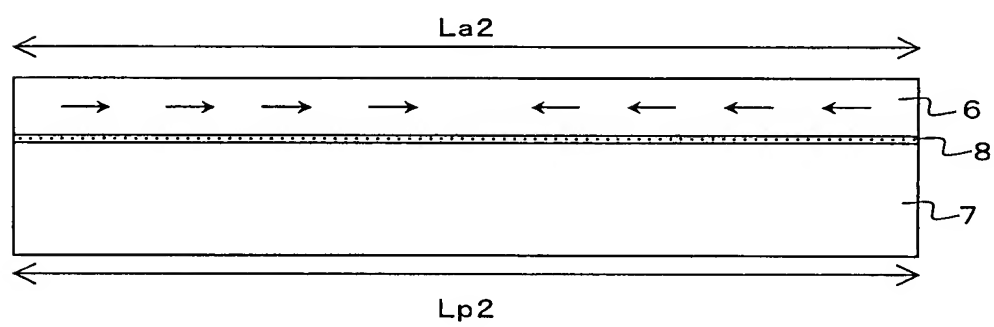


FIG. 6

Stress(MPa)	Capacitance(nF)	Voltage(V)
-50	0.97	38
-40	1	28
-20	1.05	24
0	1.13	23
10	1.2	22.3
20	1.32	22
40	1.6	21.5

FIG. 7A

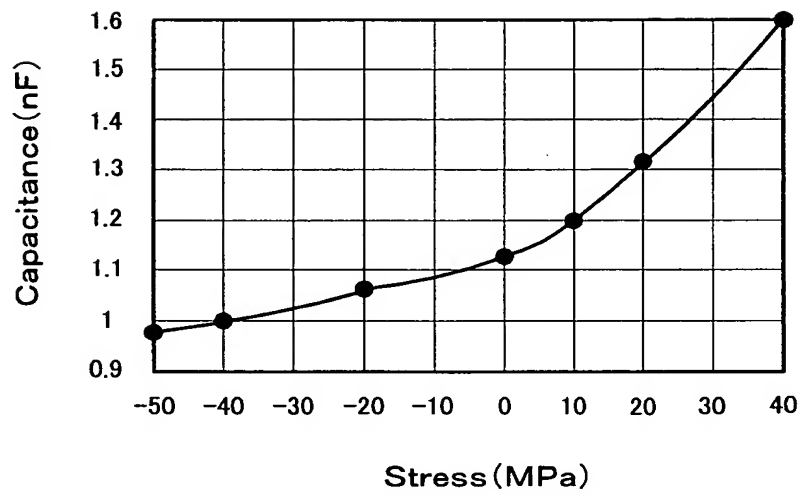


FIG. 7B

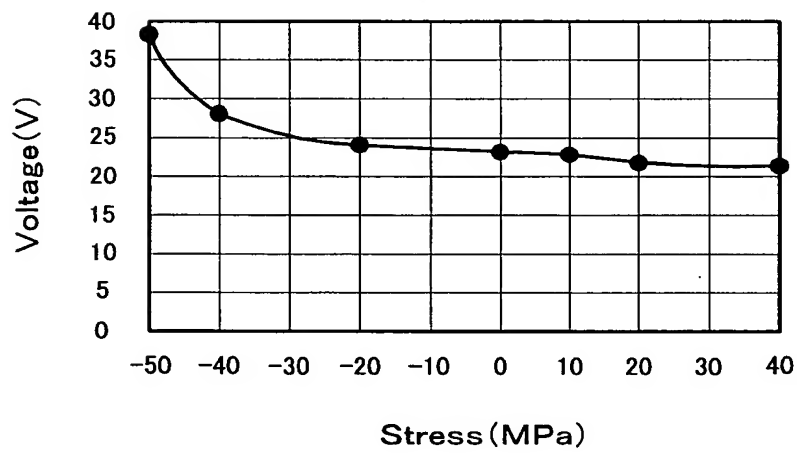




FIG. 8

		HEATING TEMPERATURE (°C)																		
		30°C	40°C	50°C	60°C	70°C	80°C	90°C	100°C	110°C	120°C	130°C	140°C	150°C	160°C	170°C	180°C	190°C	200°C	
DIFFERENCE IN LINEAR EXPANSION COEFFICIENT (ppm/°C)		-10.0	16.3	21.7	27.1	32.5	37.9	43.3	48.3	54.2	59.6	65.0	70.4	75.8	81.3	86.7	92.1	97.5	102.9	108.3
		-9.0	14.6	19.5	24.4	29.3	34.1	39.0	43.9	48.8	53.6	58.5	63.4	68.3	73.1	78.0	82.9	87.8	92.6	97.5
		-8.0	13.0	17.3	21.7	26.0	30.3	34.7	39.0	43.3	47.7	52.0	56.3	60.7	65.0	69.3	73.7	78.0	82.3	86.7
		-7.0	11.4	15.2	19.0	22.8	26.5	30.3	34.1	37.9	41.7	45.5	49.3	53.1	56.9	60.7	64.5	68.3	72.0	75.8
		-6.0	9.8	13.0	16.3	19.5	22.8	26.0	29.3	32.5	35.8	39.0	42.3	45.5	48.8	52.0	55.3	58.5	61.8	65.0
		-5.0	8.1	10.8	13.5	16.3	19.0	21.7	24.4	27.1	29.8	32.5	35.2	37.9	40.6	43.3	46.0	48.8	51.5	54.2
		-4.0	6.5	8.7	10.8	13.0	15.2	17.3	19.5	21.7	23.8	26.0	28.2	30.3	32.5	34.7	36.8	39.0	41.2	43.3
		-3.0	4.9	6.5	8.1	9.8	11.4	13.0	14.6	16.3	17.9	19.5	21.1	22.8	24.4	26.0	27.6	29.3	30.9	32.5
		-2.0	3.3	4.3	5.4	6.5	7.6	8.7	9.8	10.8	11.9	13.0	14.1	15.2	16.3	17.3	18.4	19.5	20.6	21.7
		-1.0	1.6	2.2	2.7	3.3	3.8	4.3	4.9	5.4	6.0	6.5	7.0	7.6	8.1	8.7	9.2	9.8	10.3	10.8
		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		1.0	-1.6	-2.2	-2.7	-3.3	-3.8	-4.3	-4.9	-5.4	-6.0	-6.5	-7.0	-7.6	-8.1	-8.7	-9.2	-9.8	-10.3	-10.8
		2.0	-3.3	-4.3	-5.4	-6.5	-7.6	-8.7	-9.8	-10.8	-11.9	-13.0	-14.1	-15.2	-16.3	-17.3	-18.4	-19.5	-20.6	-21.7
		3.0	-4.9	-6.5	-8.1	-9.8	-11.4	-13.0	-14.6	-16.3	-17.9	-19.5	-21.1	-22.8	-24.4	-26.0	-27.6	-29.3	-30.9	-32.5
		4.0	-6.5	-8.7	-10.8	-13.0	-15.2	-17.3	-19.5	-21.7	-23.8	-26.0	-28.2	-30.3	-32.5	-34.7	-36.8	-39.0	-41.2	-43.3
		5.0	-8.1	-10.8	-13.5	-16.3	-19.0	-21.7	-24.4	-27.1	-29.8	-32.5	-35.2	-37.9	-40.6	-43.3	-46.0	-48.8	-51.5	-54.2
		6.0	-9.8	-13.0	-16.3	-19.5	-22.8	-26.0	-29.3	-32.5	-35.8	-39.0	-42.3	-45.5	-48.8	-52.0	-55.3	-58.5	-61.8	-65.0
		7.0	-11.4	-15.2	-19.0	-22.8	-26.5	-30.3	-34.1	-37.9	-41.7	-45.5	-49.3	-53.1	-56.9	-60.7	-64.5	-68.3	-72.0	-75.8
		8.0	-13.0	-17.3	-21.7	-26.0	-30.3	-34.7	-39.0	-43.3	-47.7	-52.0	-56.3	-60.7	-65.0	-69.3	-73.7	-78.0	-82.3	-86.7
		9.0	-14.6	-19.5	-24.4	-29.3	-34.1	-39.0	-43.9	-48.8	-53.6	-58.5	-63.4	-68.3	-73.1	-78.0	-82.9	-87.8	-92.6	-97.5
		10.0	-16.3	-21.7	-27.1	-32.5	-37.9	-43.3	-48.8	-54.2	-59.6	-65.0	-70.4	-75.8	-81.3	-86.7	-92.1	-97.5	-102.9	-108.3
		11.0	-17.9	-23.8	-29.8	-35.8	-41.7	-47.7	-53.6	-59.6	-65.5	-71.5	-77.5	-83.4	-89.4	-95.3	-101.3	-107.3	-113.2	-119.2
		12.0	-19.5	-26.0	-32.5	-39.0	-45.5	-52.0	-58.5	-65.0	-71.5	-78.0	-84.5	-91.0	-97.5	-104.0	-110.5	-117.0	-123.5	-130.0
		13.0	-21.1	-28.2	-35.2	-42.3	-49.3	-56.3	-63.4	-70.4	-77.5	-84.5	-91.5	-98.6	-106.2	-113.8	-121.3	-128.9	-136.5	-144.1
		14.0	-22.8	-30.3	-37.9	-45.5	-53.1	-60.7	-68.3	-75.8	-83.4	-91.0	-98.6	-106.2	-113.8	-121.3	-128.9	-136.5	-144.1	-151.7
		15.0	-24.4	-32.5	-40.6	-48.8	-56.9	-65.0	-73.1	-81.3	-89.4	-97.5	-105.6	-113.8	-121.9	-130.0	-138.1	-146.3	-154.4	-162.5
16.0	-26.0	-34.7	-43.3	-52.0	-60.7	-69.3	-78.0	-86.7	-95.3	-104.0	-112.7	-121.3	-130.0	-138.7	-147.3	-156.0	-164.7	-173.3		
17.0	-27.6	-36.8	-46.0	-55.3	-64.5	-73.7	-82.9	-92.1	-101.3	-110.5	-119.7	-128.9	-138.1	-147.3	-156.5	-165.8	-175.0	-184.2		
18.0	-29.3	-39.0	-48.8	-58.5	-68.3	-78.0	-87.8	-97.5	-107.3	-117.0	-126.8	-136.5	-146.3	-156.0	-165.8	-175.5	-185.3	-195.0		
19.0	-30.9	-41.2	-51.5	-61.8	-72.0	-82.3	-92.6	-102.9	-113.2	-123.5	-133.8	-144.1	-154.4	-164.7	-175.0	-185.3	-195.5	-205.8		
20.0	-32.5	-43.3	-54.2	-65.0	-75.8	-86.7	-97.5	-108.3	-119.2	-130.0	-140.8	-151.7	-162.5	-173.3	-184.2	-195.0	-205.8	-216.7		
21.0	-34.1	-45.5	-56.9	-68.3	-79.6	-91.0	-102.4	-113.8	-125.1	-136.5	-147.9	-159.3	-170.6	-182.0	-193.4	-204.8	-216.1	-227.5		
22.0	-35.8	-47.7	-59.6	-71.5	-83.4	-95.3	-107.3	-119.2	-131.1	-143.0	-154.9	-166.8	-178.8	-190.7	-202.6	-214.5	-226.4	-238.3		
23.0	-37.4	-49.8	-62.3	-74.8	-87.2	-99.7	-112.1	-124.6	-137.0	-149.5	-162.0	-174.4	-186.9	-199.3	-211.8	-224.3	-236.7	-249.2		
24.0	-39.0	-52.0	-65.0	-78.0	-91.0	-104.0	-117.0	-130.0	-143.0	-156.0	-169.0	-182.0	-195.0	-208.0	-221.0	-234.0	-247.0	-260.0		
25.0	-40.6	-54.2	-67.7	-81.3	-94.8	-108.3	-121.9	-135.4	-149.0	-162.5	-176.0	-189.6	-203.1	-216.7	-230.2	-243.8	-257.3	-270.8		
26.0	-42.3	-56.3	-70.4	-84.5	-98.6	-112.7	-126.8	-140.8	-154.9	-169.0	-183.1	-197.2	-211.3	-225.3	-239.4	-253.5	-267.6	-281.7		

FIG. 9

x: DIFFERENCE IN LINEAR EXPANSION COEFFICIENT (ppm/°C)	MAXIMUM HEATING TEMPERATURE (°C)
$18 < x \leq 24$	30
$14 < x \leq 18$	40
$12 < x \leq 14$	50
$10 < x \leq 12$	60
$9 < x \leq 10$	70
$8 < x \leq 9$	80
$7 < x \leq 8$	90
$6 < x \leq 7$	100
$5 < x \leq 6$	120
$4 < x \leq 5$	140
$3 < x \leq 4$	180
$-1 < x \leq 3$	200
$-2 < x \leq -1$	180
$-3 < x \leq -2$	90
$-4 < x \leq -3$	60
$-5 < x \leq -4$	40
$-7 < x \leq -5$	30

FIG. 10

		LINEAR EXPANSION COEFFICIENT (ppm/°C)	DIFFERENCE IN LINEAR EXPANSION COEFFICIENT (ppm/°C)	HEATING TEMPERATURE (ppm/°C)
ACTUATOR UNIT	PZT	5	—	—
PASSAGE UNIT	SUS430	10. 4	5. 4	120 or less
	SUS304	17. 3	12. 3	50 or less
	42 ALLOY	4. 5	—0. 5	200 or less